

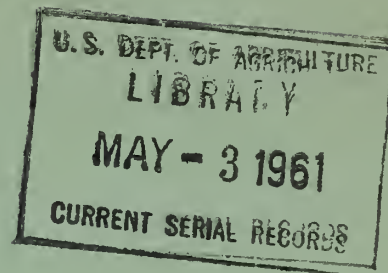
Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

A 45.9
So 8
Cop. 2

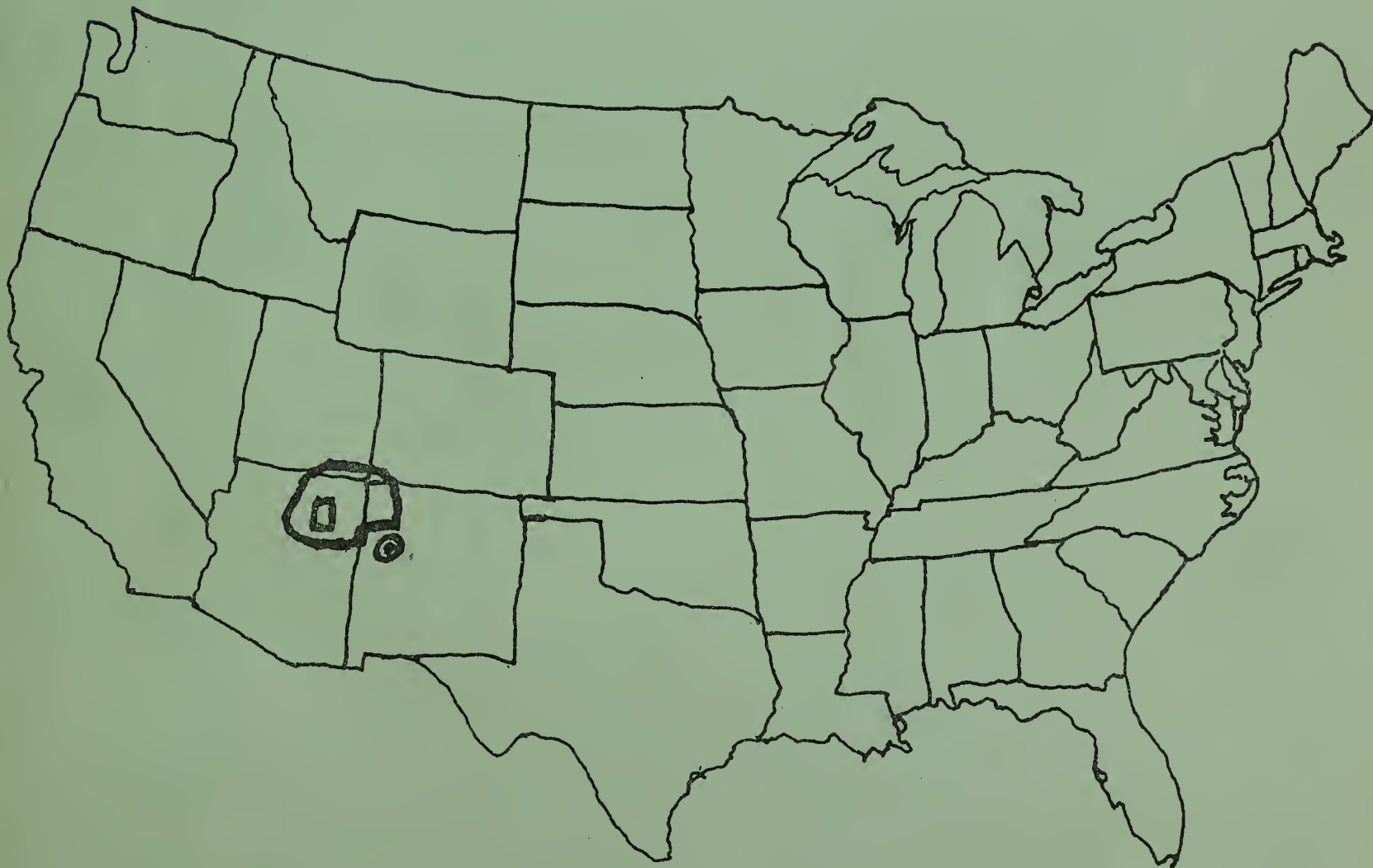
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS



TENTH ANNUAL REPORT OF THE
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

OCTOBER 31, 1946



THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE
USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF
RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

ANNUAL REPORT OF CONDITIONS AND ACTIVITIES
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

November 1, 1945 to October 31, 1946

TABLE OF CONTENTS

	Page
ROSTER OF PERSONNEL.....	1
OBJECTIVE.....	2
RESEARCH LINE PROJECTS.....	2
PUBLICATIONS.....	2
SUMMARY OF BREEDING PROGRAM.....	5
CHARACTERISTICS OF BREEDING RAMS.....	5
CHARACTERISTICS OF BREEDING EWES.....	9
LAMB PRODUCTION OF NAVAJO AND CROSSBRED LINES.....	9
FIBER CHARACTERISTICS OF WEANLING LAMBS.....	13
FACE AND BODY SCORES FOR WEANLING EWE LAMBS.....	14
CHARACTERISTICS OF YEARLING EWES.....	16
WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED RAMS.....	17
GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS.....	18
DISPOSITION OF WOOL.....	19
RAMS AND RAM LAMBS SOLD FOR BREEDING USE ON NAVAJO INDIAN RESERVATION....	19

ROSTER OF PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
Grandstaff, James O.	Animal Husbandman, P&S-4	Jan. 13, 1944	Director
Wolf, Harold W.** ¹	Animal Fiber Tech., P-3	Mar. 1, 1945	Wool Tech.
King, Herbert T.*	Ass't. Animal Husbandman, P-2	Oct. 1, 1936	Operations
Anderson, Alfred T.***	Stockman, CPC-7	Mar. 22, 1945	Operations
Schild, Edna F.	Clerk, CAF-4	Nov. 11, 1936	Clerical
McKay, Roy H.** ²	Scientific Aid, SP-4	Aug. 13, 1945	Assistant
Propps, Orville D.****	Scientific Aid, SP-4	Apr. 12, 1941	Assistant
Gleason, Jimmie	Ass't. Ind. Gen. Mech.	Apr. 1, 1942	Maintenance
Chadacloi, Marion	Ass't. Ind. Lab. Aid	Jan. 12, 1944	Lab. Aid
Salabiye, Teresia** ³	Ass't. Ind. Lab. Aid	Jan. 1, 1944	Lab. Aid
Naswood, Glen** ⁴	Ass't. Ind. Stockman	Sept. 6, 1944	Livestock
Denetclaw, Jessie	Ass't. Ind. Lab. Aid	Oct. 1, 1942	Weaver
Fisher, Phoebe	Ass't. Ind. Lab. Aid	May 25, 1942	Weaver
Bia, Wilfred** ⁵	Ass't. Ind. Stockman	Mar. 19, 1946	Livestock
O'dell, Billy	Ass't. Ind. Stockman	Aug. 19, 1946	Livestock
Roanhorse, Douglas	Ass't. Ind. Stockman	Aug. 26, 1946	Livestock

* On military leave

**¹ Resigned: Aug. 28, 1946

**² Resigned: May 1, 1946

**³ Resigned: Aug. 19, 1946

**⁴ Resigned: May 9, 1946

**⁵ Resigned: Aug. 16, 1946

*** Transferred: Aug. 11, 1946

**** Promoted to Animal Husbandman, P-1:
Aug. 11, 1946

-f-

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool with respect to hand weaving are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

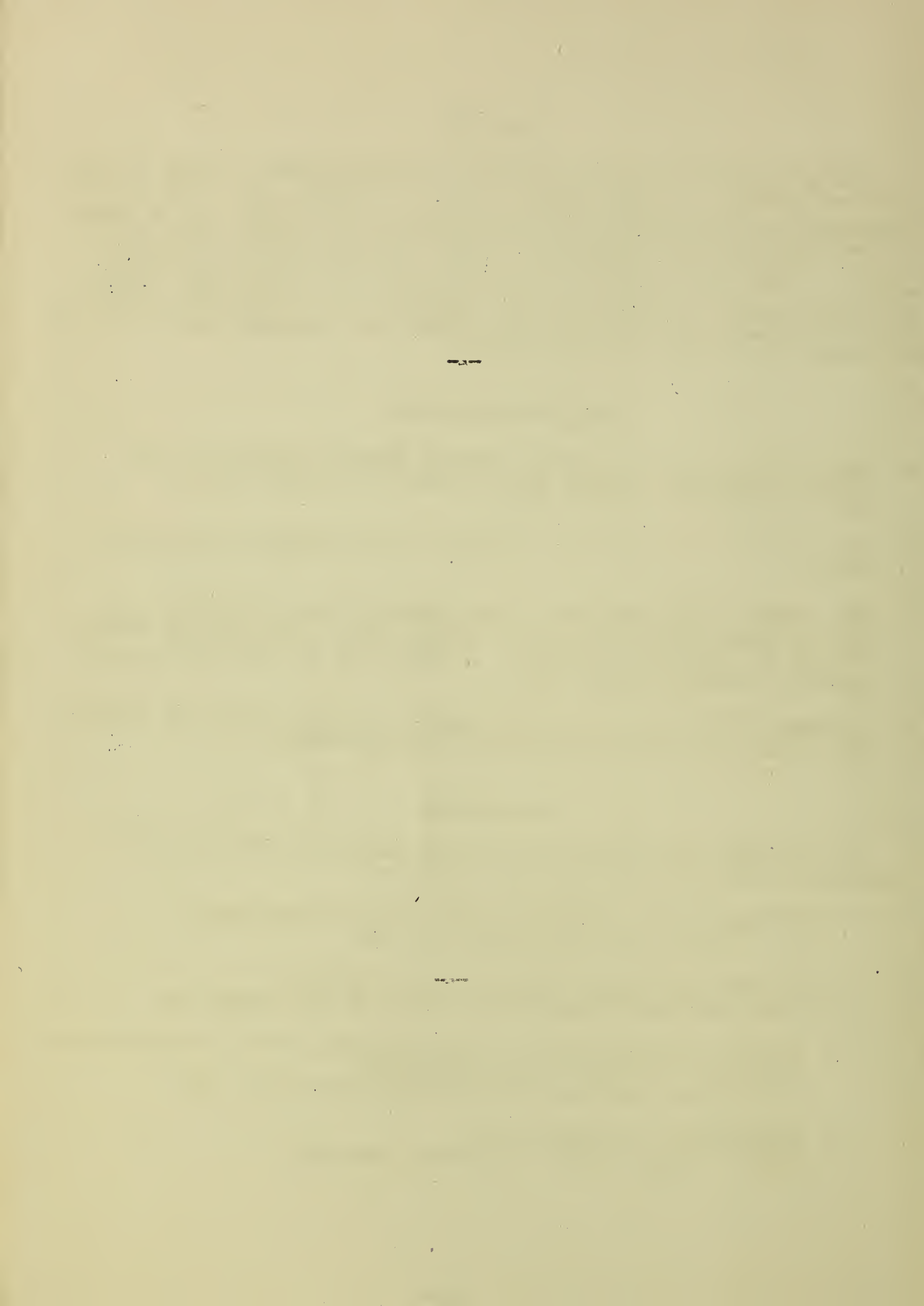
RESEARCH LINE PROJECTS

1. Improvement of the wool of Navajo sheep by studying the physical and chemical properties of Navajo wool as found in old Navajo blankets, and in the fleeces of Navajo sheep.
2. Improvement of Navajo sheep by selection and line breeding in the Navajo strain.
3. Improvement of sheep for use of Navajo Indians through crossbreeding of old-type Navajo sheep with improved breeds such as Romney and Corriedale, followed by selective line-breeding matings of the F₁ (and succeeding generations) crossbred animals inter se.
4. Improvement of wool to meet the requirements of Navajo Indians by studying the physical and chemical properties of crossbred wools.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement;
J. M. Cooper, The Sheep Breeder, May 1939
2. The Sheep Industry of Indians in the Southwest;
J. M. Cooper and Dewey Dismuke, Indians At Work, August 1939
3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation;
J. M. Cooper, American Society of Animal Production, 1939
4. Improvement of the Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, March 1940



5. Breeding for Quality Wool;
James O. Grandstaff, The National Wool Grower, July 1940
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers;
James O. Grandstaff and Walter L. Hodde, Circular No. 590, U.S. Department of Agriculture, December 1940
7. Evaluating Fleece Characteristics of Navajo Sheep;
James O. Grandstaff, Rayon Textile Monthly, October-November 1941
8. Wool Characteristics in Relation to Navajo Weaving;
James O. Grandstaff, Technical Bulletin No. 790, U.S. Department of Agriculture, January 1942
9. Characteristics and Production of Old-Type Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, May 1943
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs;
Cecil T. Blunn, Journal of Animal Science, February 1944
11. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep;
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944
12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep;
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944
13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs;
Cecil T. Blunn, Journal of Animal Science, August 1945
14. Evaluating Fleece Quality of Navajo Sheep from Small Samples;
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945
15. Improvement of Wool for Navajo Hand Weaving;
James O. Grandstaff and Cecil T. Blunn, Indians At Work, March 1945
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs;
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947

SUMMARY OF BREEDING PROGRAM

<u>Line</u>	<u>Sub-line</u>	<u>Pen no.</u>	<u>Ram</u>	<u>Breeding of rams</u>	<u>Breeding of ewes</u>	<u>No. of ewes</u>
1		1	171E	Navajo	Navajo	39
2		2	83E	Navajo	Navajo	42
6		W1	5002K	Columbia	Navajo	31
6		W2	3734K	Columbia	Navajo	32
6		W3	4061K	Columbia	Navajo	31
6		W4	4263K	Columbia	Navajo	32
6		W5	4759K	Columbia	Navajo	28
6		W6	4969K	Columbia	Navajo	32
3	1	W7	W280F	Crossbred	Crossbred	51
3	2	W8	W181F	Crossbred	Crossbred	44
3	3	W9	W137G	Crossbred	Crossbred	24
3	3	W10	W175F	Crossbred	Crossbred	31
4	1	W11	W11G	Crossbred	Crossbred	42
4	1	W12	W74F	Crossbred	Crossbred	40
4	2	W13	W1123 W218H	Crossbred	Crossbred	37
4	3	W14	W20G	Crossbred	Crossbred	32
5		W15	1336	Cotswold	Crossbred	52
5		W16	1343	Cotswold	Crossbred	50
5		W17	1349	Cotswold	Crossbred	49
Test Pens		1	W256H	Crossbred	Crossbred	24
		2	W338H	Crossbred	Crossbred	20
		3	W32G	Crossbred	Crossbred	21

SUMMARY OF BREEDING PROGRAM

The breeding flock in 1945 contained a total of 784 ewes, which represented an increase of about 11 percent over the number of ewes bred in 1944. Included in the 1945 total were 269 Navajo ewes and 515 crossbred ewes, of which 65 were used in test pens.

The number of lines of breeding was increased from four to six by the addition of two new crosses. One hundred eighty-six of the most desirable Navajo ewes were mated to six coarse-wooled Columbia rams obtained from the U.S. Sheep Experiment Station, Dubois, Idaho. This cross is identified in the breeding summary as line 6.

A considerable number of the ewes in lines 3 and 4 produced wool that was too short and fine for hand weaving purposes. One hundred fifty-one of these fine-wooled segregates were bred to three Cotswold rams, as a corrective mating. This cross is identified in the preceeding summary as line 5. The number of ewes available for breeding in lines 3 and 4 were reduced to 150 and 151 respectively, by the withdrawal of ewes for line 5. The foundation ewes of line 3 were first-cross Corriedale x Navajo, and those of line 4 were Romney x Navajo crosses.

Only 81 Navajo ewes were available for breeding to Navajo rams. This number is not sufficient to produce the necessary replacement ewes, and must be increased somewhat in 1946.

The ewes were pen bred during the 30-day period November 7 to December 6 inclusive. Thus, the breeding period was a month earlier than in previous years.

CHARACTERISTICS OF BREEDING RAMS

Selection of satisfactory breeding rams has been complicated by the limited numbers available, and the numerous characteristics to be considered. New rams have been selected primarily on the basis of their fleece characteristics, giving special attention to kemp and other medullated fibers, grade and uniformity of the wool and length of staple. Rams with the coarsest fleeces were used if otherwise acceptable, because of the need for correcting deficiencies in fleece fineness of the breeding flock. Rams which had proven their ability to improve the fleeces of their progeny were used in preference to untested ram. Progress in wool improvement might be accelerated if a larger number of ram lambs could be tested each year, and the top rams selected at yearling age for use in the regular breeding lines.

Data on important fleece characteristics of the rams used for breeding in 1945-46 are summarized in the following table:

CHARACTERISTICS OF BREEDING RAMS

Line no.	Ram no.	Age at breeding	Fleece weight as yearling		Staple length (cms.)	Fineness at side		Kemp (%)	Other med. fibers (%)
			Grease: (lbs.)	Clean (lbs.)		Diameter: (microns)	Grade		

NAVAJO RAMS:

1	171E	3	11.15	8.80	19.6	36.5	44's	0	0
2	83E	3	8.20	5.03	18.5	29.2	50's	0	0
Average, Lines 1 & 2			9.68	6.92	19.0	32.8	48's	0	0

CROSSBRED RAMS:

3	W280F	2	8.20	3.90	15.1	31.7	48's	0	0
3	W181F*	2	12.00	8.18	20.3	31.4	50's	0	0
3	W137G	1	7.40	3.70	17.3	33.8	46's	0	0
3	W175F	3	10.00	5.10	18.6	29.2	50's	0	0
Average, Line 3			9.40	5.22	17.8	31.5	50's	0	0

4	W11G	1	9.00	5.30	16.5	30.0	50's	0	0
4	W74F	2	7.85	4.45	16.5	32.3	48's	0	0
4	W218H	Lamb	8.75	5.78	23.0	28.7	56's	0	0
4	W20G*	1	10.65	5.99	15.3	31.4	50's	0	0
Average, Line 4			9.06	5.38	17.8	30.6	50's	0	0

COTSWOLD RAMS:

5	1336	1	16.50	10.40	36.6	34.6	46's	0	9.5
5	1343	1	17.25	10.16	39.5	34.6	46's	0	30.9
5	1349**								
Average, Line 5			16.88	10.28	38.0	34.6	46's	0	20.2

COLUMBIA RAMS:

6	3734K	4	16.90	8.53	12.2	28.2	56's	0	0
6	4061K	3	18.70	7.00	14.5	30.8	50's	0	0
6	4263K	2	17.35	8.64	12.7	29.4	50's	0	0
6	4759K	1	12.10	6.05	15.9	29.7	50's	0	0
6	4969K	1	10.70	5.21	15.5	30.2	50's	0	0
6	5002K	1	11.10	4.51	16.2	28.7	56's	0	6.5
Average, Line 6			14.48	6.66	14.5	29.5	50's	0	0.9

*1946 fleece weights used

**No fleece data - ram died March 1946

The determinations for fineness, length of staple, and percentages of kemp and other medullated fibers were made on side samples collected just before the yearling fleeces were sheared. The scoured fleece weight was calculated by applying the yield of the side sample to the grease weight of the fleece. The two Navajo rams used for breeding in 1945 were three years of age and had been used for breeding one or more years, with good results, particularly with respect to fleece improvement. These rams had well-improved fleeces containing but few outercoat fibers and no kemp or other medullated fibers, good length of staple, and better than average yield of wool for the Navajo breed. The ram 171E was an outstanding specimen in size, type and wool production.

A total of eight crossbred rams were used in lines 3 and 4. The fleeces of all of these rams were free from kemp and other medullated fibers, but most of them were somewhat finer than the desired grade of 48's. Average fineness for the rams of each line was equal to grade 50's, with a staple length of 17.8 centimeters.

Yields of clean wool from yearling fleeces varied from 3.70 pounds to 8.18 pounds, with an average of 5.22 pounds for the rams of line 3 and 5.38 pounds for the rams of line 4. Clean fleece weights, except for two rams, were comparable to those of the Columbia rams used in line 6; but it appears that there is ample opportunity for further improvement in fleece weight through selection. The small numbers of coarse-fleeced ram lambs produced in these lines continues to be a limiting factor in the selection of rams with higher wool production.

The Cotswold rams, selected from a very limited number of purebred rams available, left some things to be desired with respect to fleece quality. One ram, number 1343, had 30.9 percent medullated fibers, while the average of the two rams used was 20.2 percent. Neither fleece, however, contained any kemp. The fleece weights were satisfactory for both rams, with an average of 16.88 pounds grease weight, and 10.28 pounds scoured weight. Staple length average was 38 centimeters, while the average fiber diameter was 34.6 microns, equivalent to the grade of 46's.

The Columbia rams, while selected primarily for coarse fleeces, also were good breed specimens from the standpoint of body size and type. None of these rams had any kemp fibers in their fleeces, and only one of the six showed any medullated fibers other than kemp. Their yearling fleeces had an average weight of 14.48 pounds, with a clean wool yield of 6.66 pounds. The average fiber diameter was 29.5 microns, grade 50's, and staple length average of 14.5 centimeters.

The data included in the table are for determinations made on the yearling fleeces. Fineness, kemp and other medullated fibers, and staple length are for the side. Scoured fleece weight was calculated from the yield obtained by scouring a side sample.

CHARACTERISTICS OF BREEDING EWES

Line no.	Pen no.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo.	Fleece weight as yearling		Fineness at side	
					Grease : Clean (lbs.) (lbs.)		Diameter : Grade (microns)	

NAVAJO EWES BRED TO NAVAJO RAMS:

1	1	39	5.4	98.4	4.99	2.87	24.7	60's
2	2	42	4.8	102.1	4.58	2.63	24.0	62's
Total and average, Lines 1 & 2		81	5.1	100.2	4.78	2.75	24.4	60's

NAVAJO EWES BRED TO COLUMBIA RAMS:

6	W1	31	5.5	96.8	4.96	3.22	25.8	58's
6	W2	32	4.7	103.3	5.58	3.15	26.5	58's
6	W3	31	4.8	98.9	5.37	3.30	26.6	58's
6	W4	32	4.4	99.8	5.44	3.40	27.2	56's
6	W5	28	3.9	100.1	5.56	3.28	26.8	58's
6	W6	32	4.3	99.7	5.48	3.39	26.7	58's
Total and average, Line 6		186	4.6	99.8	5.40	3.29	26.6	58's

CROSSBRED EWES BRED TO CROSSBRED RAMS:

3	W7	51	3.9	105.6	6.62	3.38	27.9	56's
3	W8	44	4.4	105.4	7.11	3.91	25.6	58's
3	W9	24	5.2	109.7	6.44	3.64	25.3	60's
3	W10	31	4.2	105.8	6.46	3.51	25.0	60's
Total and average, Line 3		150	4.4	106.6	6.66	3.61	26.0	58's

4	W11	42	5.6	100.0	6.45	3.97	28.7	56's
4	W12	40	3.4	112.7	6.34	3.61	28.4	56's
4	W13	37	4.3	107.1	6.66	3.72	25.6	58's
4	W14	32	3.8	106.4	5.79	3.10	25.4	60's
Total and average, Line 4		151	4.3	106.6	6.31	3.60	27.0	58's

CROSSBRED EWES BRED TO COTSWOLD RAMS:

5	W15	52	4.4	108.9	6.46	3.20	22.9	62's
5	W16	50	4.7	106.4	5.96	3.08	24.8	60's
5	W17	49	3.9	106.4	6.58	3.14	25.5	60's
Total and average, Line 5		151	4.3	107.2	6.33	3.14	24.4	60's

CHARACTERISTICS OF BREEDING EWES

Data on age, body weight and various fleece characteristics of the ewes are summarized by pens and lines of breeding in the preceeding table.

The Navajo ewes bred to Columbia rams were superior to those bred to Navajo rams, in all characteristics except body weight at 18 months of age. They averaged 0.5 of a year younger at lambing, produced 0.54 of a pound more clean wool per head as yearlings, and the wool averaged 2.2 microns coarser in fiber diameter at the side. Five of the six pens of Navajo ewes bred to Columbia rams had an average wool fineness between 25.8 and 26.8 microns, corresponding to grade 58's; while pen W4 averaged 27.2 microns or grade 56's. The two pens of ewes bred to Navajo rams had an average fineness of 24.3 microns, grade 60's.

The crossbred ewes in lines 3 and 4 were sorted for breeding according to the length and fineness of their wool. Pen W7 in line 3, and pens W11 and W12 in line 4, contained ewes with fleeces grading three-eighths blood and quarter-blood. Ewes with long-staple wool grading half-blood were assigned to pens W8 and W13, while the shorter-stapled ewes grading high half-blood or fine were assigned to pens W9, W10 and W14. It would be logical to expect that the long-stapled ewes would have the highest yield of clean wool. This relationship held true except for pen W7, which for some unknown reason had the lowest clean wool yield of any pen in line 3. There was very little difference between the means of lines 3 and 4; both lines had an average fiber diameter equal to grade 58's, a clean wool production of about 3.6 pounds, and body weight of 106.5 pounds at 18 months of age. Their average age at lambing was 4.3 years.

The crossbred ewes mated to Cotswold rams not only had finer and shorter wool, but a lower yield than the more desirable ewes remaining in lines 3 and 4. Their average fiber diameter was 24.4 microns, grade 60's, with a yield of only 3.14 pounds of clean wool.

LAMB PRODUCTION OF NAVAJO AND CROSSBRED LINES

Data on lamb production in 1946 is summarized in the following table, which also includes average values for the 9-year period 1937-45. In 1946 the lambs were born in April, 30 days earlier than in previous years, and weaning weights of the lambs were adjusted to a constant age of 140 days. Lamb production in 1946 was quite satisfactory from the standpoint of numbers, but weaning weights were low as a result of the severe drought experienced in this area. Total precipitation at Fort Wingate, during the first six months of the year amounted to only 1.56 inches, causing a critical shortage of feed and water for livestock. The lambs received a check in growth during the first 60 days after birth, which was not overcome by improved feed conditions in July and August.

The Navajo ewes in lines 1 and 2 established new high records in 1946, with respect to percentages of ewes lambing and percentages of lambs born and raised. The number of Navajo lambs weaned was equivalent to 142 percent of the number of ewes bred, exceeding the 9-year average by 42 percent. Weaning weights of the lambs were low but the production of lamb per ewe bred amounted to 74.9 pounds, an increase of 17.2 pounds over the 9-year average. With a high rate of reproduction and the ability to raise a very high percentage of their lambs, Navajo ewes quite consistently have produced more pounds of lamb than crossbred ewes. The advantage of Navajo compared to crossbred matings in 1946 was 16.3 pounds of lamb per ewe bred. In this instance, however, the number of Navajo matings was small, since most of the Navajo ewes were bred to Columbia rams.

Crossbred matings representing four different lines of breeding produced from 89.4 to 111.3 lambs per hundred ewes bred, with an average of 102.7 for all lines. The latter figure represents an increase of 12.9 percent over the 9-year average. Line 6, Columbia x Navajo, had a higher percentage of ewes lambing, and weaned a higher percentage of the lambs born than did other crossbred lines. Lambs of the Columbia cross also had the highest average weaning weight, but were somewhat more variable in type and size than other crossbred lambs. Results obtained from the use of Cotswold rams were very spotty. The ewes of pen W15 weaned 132.7 percent of lambs, with an average weaning weight of 58.9 pounds. Thus, they produced more pounds of lamb per ewe bred than any other crossbred or Navajo pen. On the other hand, lamb production of pens W16 and W17 was below average. Lambs of this cross were essentially three-fourths improved blood and one-fourth Navajo blood. This may account for the fact that the percent mortality of lambs in line 5 was slightly higher than observed for other crossbred lines, in which the lambs were half Navajo and half improved; but definite conclusions cannot be drawn from one year's results.

Average weaning weights of lambs produced in lines 3 and 4 were low, and also the percentage of lambs weaned in line 4 was well below the average of other lines because of the small percentage of ewes lambing in pen W11.

--10--

--10--

LAMB PRODUCTION OF NAVAJO AND CROSSBRED LINES

Line no.	Pen no.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes lambing	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight	Pounds of lamb per ewe bred
1	1	39	97.4	157.9	141.0	98.2	52.2	73.5
2	2	42	97.6	156.1	142.9	95.2	53.4	76.3
Total and average, Lines 1 & 2		81	97.5	157.0	142.0	97.5	52.8	74.9

NAVAJO EWES BRED TO COLUMBIA RAMS:

6	W1	31	90.3	150.0	116.1	83.7	55.1	64.2
6	W2	32	78.1	156.0	103.1	89.2	61.5	63.0
6	W3	31	93.6	127.0	109.7	91.9	61.4	67.4
6	W4	32	84.4	137.0	106.2	94.4	62.4	66.3
6	W5	28	85.7	158.3	121.4	89.5	55.6	67.9
6	W6	32	84.4	144.4	112.5	92.3	58.5	65.8
Total and average, Line 6		186	86.0	145.0	111.3	90.8	59.0	65.7

CROSSBRED EWES BRED TO CROSSBRED RAMS:

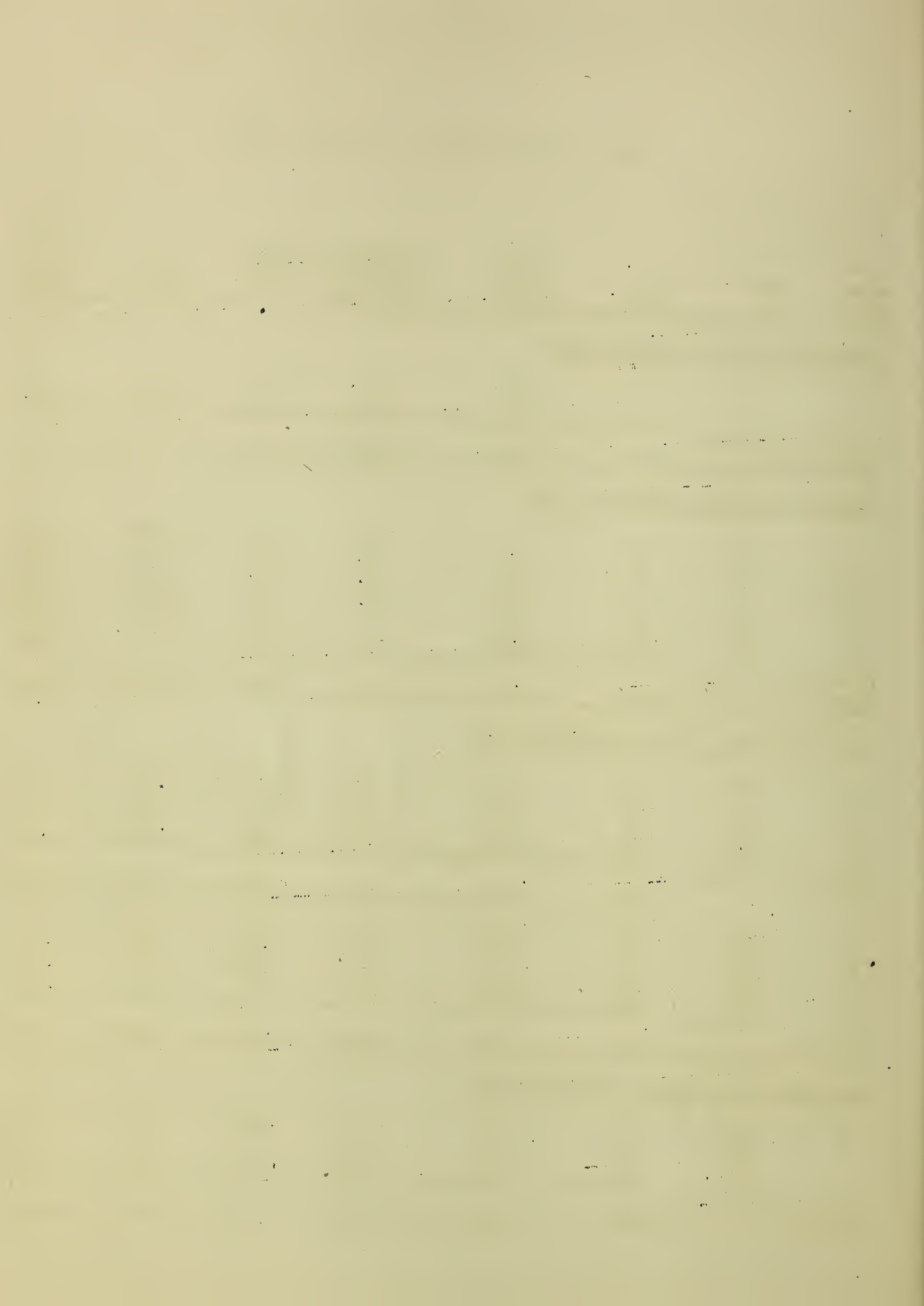
3	W7	51	84.3	139.5	98.0	83.3	58.4	57.2
3	W8	44	86.4	173.0	131.8	92.1	53.8	70.9
3	W9	24	83.3	145.0	100.0	82.7	54.8	55.1
3	W10	31	80.6	148.0	96.8	81.1	55.6	53.8
Total and average, Line 3		150	84.0	150.8	108.0	85.7	55.7	60.2
4	W11	42	28.6	150.0	135.7	83.3	57.9	20.7
4	W12	40	100.0	130.0	105.0	87.5	57.0	59.8
4	W13	37	86.5	156.3	113.5	84.0	53.6	60.2
4	W14	32	87.5	150.0	112.5	87.8	55.0	61.9
Total and average, Line 4		151	74.2	153.6	89.4	56.0	55.5	49.5

CROSSBRED EWES BRED TO COTSWOLD RAMS:

5	W15	52	98.1	156.9	132.7	86.2	58.9	78.0
5	W16	50	86.0	146.5	94.0	75.8	58.9	55.4
5	W17	49	49.0	183.3	71.4	89.7	53.5	38.2
Total and average, Line 5		151	78.1	158.5	100.0	83.4	57.6	57.6
Total and average, Lines 3,4,5 & 6		638	80.7	149.7	102.7	86.7	57.2	58.6
NAVAJO AVERAGE, 1937-45			88.1	131.9	100.0	89.1	57.7	57.7
CROSSBRED AVERAGE, 1937-45			83.5	130.8	89.8	83.5	61.2	55.0

FIBER CHARACTERISTICS OF WEANLING LAMBS

Line no.	Pen no.	No. of lambs	Staple length (cms.)	Fineness at side Diameter : Grade (microns)		Kemp (%)	Other med. fibers (%)
<u>NAVAJO EWES BRED TO NAVAJO RAMS:</u>							
1	1	53	7.87	26.8	58's	0.61	3.80
2	2	58	7.41	26.7	58's	0.20	3.02
Total and average, Lines 1 & 2		111	7.63	26.8	58's	0.40	3.35
<u>NAVAJO EWES BRED TO COLUMBIA RAMS:</u>							
6	W1	36	5.99	26.2	58's	0.87	5.35
6	W2	33	4.96	26.0	58's	0.31	2.51
6	W3	34	5.42	26.1	58's	0.35	2.04
6	W4	34	6.09	26.7	58's	2.87	2.87
6	W5	34	5.90	25.2	60's	0.74	4.23
6	W6	36	6.40	25.6	58's	0.78	3.83
Total and average, Line 6		207	5.80	26.0	58's	0.56	3.14
<u>CROSSBRED EWES BRED TO CROSSBRED RAMS:</u>							
3	W7	49	6.36	27.5	60's-58's	1.50	3.50
3	W8	58	6.55	25.5	60's-58's	0.49	1.49
3	W9	24	5.53	26.0	58's	0.84	1.67
3	W10	31	5.94	24.1	60's	0.50	2.44
Total and average, Line 3		162	6.23	25.9	58's	0.84	2.30
4	W11	15	7.27	27.6	56's	1.19	2.93
4	W12	40	6.39	27.1	56's	0.46	1.98
4	W13	42	6.77	26.7	58's	0.57	1.87
4	W14	37	6.30	27.5	56's	1.00	2.84
Total and average, Line 4		134	6.59	27.2	56's	0.73	2.29
<u>CROSSBRED EWES BRED TO COTSWOLD RAMS:</u>							
5	W15	67	9.45	25.6	58's	0.76	3.51
5	W16	49	9.16	26.6	58's	0.12	3.44
5	W17	35	9.23	25.3	60's	0.19	4.58
Total and average, Line 5		151	9.31	25.8	58's	0.42	3.76



FIBER CHARACTERISTICS OF WEANLING LAMBS

Samples of fibers collected from the middle of the left side and thigh of each lamb, at weaning time, were evaluated for length of staple, fineness and percentages of kemp and other medullated fibers. Data on the side samples from 111 Navajo and 655 crossbred lambs are summarized by pens and lines in the preceding table. Average values for the thigh samples, not given in this table, were consistently larger than those for side samples. Thus, the wool in the thigh region of the fleeces not only was longer and coarser, but also contained more kemp and other medullated fibers than the side samples. This condition is to be expected as the thigh is one of the last regions of the fleece to improve. The data for each characteristic were analyzed by Analysis of Variance.

The Navajo lambs, lines 1 and 2, had an average staple length of 7.63 centimeters which exceeded the average of all crossbred lines, except line 5. Differences between lambs within sires, and between pens and lines were not significant, indicating good uniformity of the lambs with respect to staple length. Differences between sexes and regions were highly significant.

The lambs of line 5, sired by Cotswold rams, had an average staple length of 9.31 centimeters, and were significantly longer staple than those of other crossbred lines. The Columbia x Navajo lambs had the shortest staple, averaging 5.80 centimeters; while the lambs of lines 3 and 4 were intermediate in staple length between those of lines 5 and 6. The variance in staple length for lambs within sires, sires within lines, lines, sexes and regions gave highly significant F values. Differences between side and thigh samples were the source of greatest variance, while differences between lambs within sires were the source of least variance.

Navajo lambs, lines 1 and 2, with an average fiber diameter of 26.8 microns, had slightly coarser wool than the lambs of any crossbred line, except line 4. The Navajo lambs showed a substantial improvement in fiber diameter, compared to their dams. The variances for lines and sexes were not significant, but differences between lambs within sires and between regions of the fleece were highly significant.

For crossbred lambs the variance in fineness for lambs within sires, sires within lines, lines, sexes and regions were highly significant. Regions had the greatest variance, and lambs within sires the least variance. The progeny of lines 3, 4 and 5 showed some improvement in fiber diameter compared to their dams, the gain being greatest for line 5.

Average values for kemp and other medullated fibers, except for line 5, were consistently lower than those observed for lambs born in 1945; indicating that definite progress in wool improvement is being made. Navajo lambs, lines 1 and 2, had an average of only 0.40 percent kemp which was slightly less than the amount observed for any crossbred lines. Regions contributed the greatest

1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900

1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100

2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200

2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
2222
2223
2224
2225
2226
2227
2228
2229
2230
2231
2232
2233
2234
2235
2236
2237
2238
2239
2240
2241
2242
2243
2244
2245
2246
2247
2248
2249
2250
2251
2252
2253
2254
2255
2256
2257
2258
2259
2260
2261
2262
2263
2264
2265
2266
2267
2268
2269
2270
2271
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
2286
2287
2288
2289
2290
2291
2292
2293
2294
2295
2296
2297
2298
2299
2300

variance, and lambs within sires the least variance. The F values for all sources of variance, for both Navajo and crossbred lambs, were highly significant; but for lambs with sires, lines, and regions the variance in each instance was highly significant.

Lambs sired by Cotswold rams had the highest percentage of medullated fibers. Differences between lines, and between regions of the fleeces were highly significant, whereas differences between lambs within sires, sires within lines and sexes were not significant.

FACE AND BODY SCORES FOR WEANLING EWE LAMBS

The ewe lambs were scored for face covering, body type and condition at the time they were weaned from their dams. Ram lambs were not scored due to the lack of sufficient personnel to complete the work in the limited time available. The data have not yet been analyzed to determine the significance of differences within and between pens and lines, but average values for each trait are given in the following table.

These data show that the Navajo lambs had more open faces than crossbred lambs, whereas the crossbreds were superior in type and condition. These results are logical and confirm previous observations, although 1946 was the first year that the lambs were actually scored for these characteristics. The characteristic of open faces is well fixed in Navajo sheep. Also, they are narrow bodied, upstanding, pinched in the heart girth, cut up in the twist and light in the leg, all of which are associated with poor mutton type and condition. Mutton qualities are being improved through crossbreeding, but careful attention must be given to the selection of breeding rams in order to retain the desired open-ness of face.

The lambs sired by Cotswold rams were slightly superior in type, although differences between the means of the four crossbred lines were quite small.

The Columbia x Navajo lambs scored highest on condition, which was rather surprising, although it may reflect the superiority of Navajo ewes in milk production. High condition of lambs at weaning age cannot be expected under southwestern range conditions, except where the sheep have access to good mountain range.

FACE AND BODY SCORES FOR WEANLING EWE LAMBS

Line no.	Pen no.	No. of lambs	Face covering	Type	Condition
----------	---------	--------------	---------------	------	-----------

NAVAJO EWES BRED TO NAVAJO RAMS:

11	1	22	2.96	3.49	3.68
2	2	23	2.95	3.77	3.90
Total and average, Lines 1 and 2		45	2.95	3.63	3.79

CROSSBRED EWES BRED TO CROSSBRED RAMS:

3	W7	19	3.21	3.29	3.00
3	W8	29	3.63	3.36	3.34
3	W9	10	3.93	3.27	3.27
3	W10	16	3.56	3.15	3.06
Total and average, Line 3		74	3.55	3.28	3.18

4	W11	5	3.22	3.04	2.72
4	W12	16	3.35	3.58	3.54
4	W13	19	3.01	3.30	3.45
4	W14	18	2.64	3.04	3.18
Total and average, Line 4		58	3.00	3.27	3.33

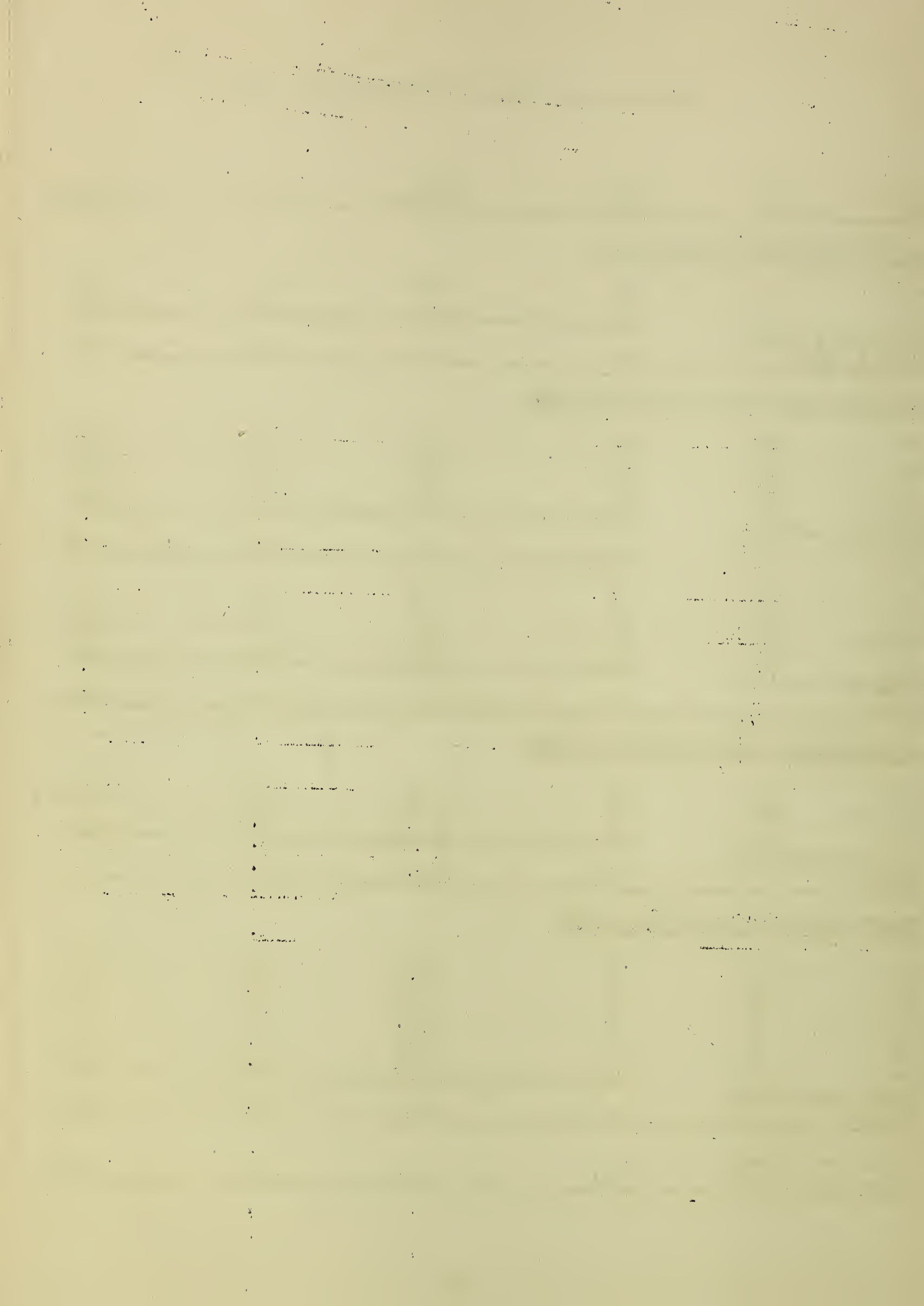
CROSSBRED EWES BRED TO COTSWOLD RAMS:

5	W15	31	3.52	3.08	3.47
5	W16	26	3.58	3.11	3.34
5	W17	16	4.04	3.27	3.61
Total and average, Line 5		73	3.65	3.13	3.54

NAVAJO EWES BRED TO COLUMBIA RAMS:

6	W1	17	2.95	3.30	3.18
6	W2	14	3.30	3.16	2.95
6	W3	15	3.30	3.27	3.28
6	W4	19	3.12	3.08	3.05
6	W5	18	3.34	3.36	3.14
6	W6	14	3.25	2.95	2.93
Total and average, Line 6		97	3.21	3.19	3.09

Total and average, Lines 3, 4, 5 & 6		302	3.36	3.22	3.25
--------------------------------------	--	-----	------	------	------



CHARACTERISTICS OF YEARLING EWES

The fleeces of all yearling ewes were sampled from the middle of the left side before the sheep were sheared. These samples were used to measure length of staple, fineness, percentages of kemp and other medullated fibers, and yield of clean wool. Each fleece, at shearing time, was weighed to the nearest 0.05 pound, and the estimated clean wool content was determined by the side sample method. Body weights of the sheep were taken immediately after they were sheared.

Data on the various characteristics of the yearling ewes are summarized in the following table:

Line no.	No. of ewes	Yield (%)	Fleece weight		Fineness at side		Staple length (cms.)	Kemp (%)	Med. fibers	Body weight
			Grease: (lbs.)	Clean (lbs.)	Diameter (microns)	Grade				

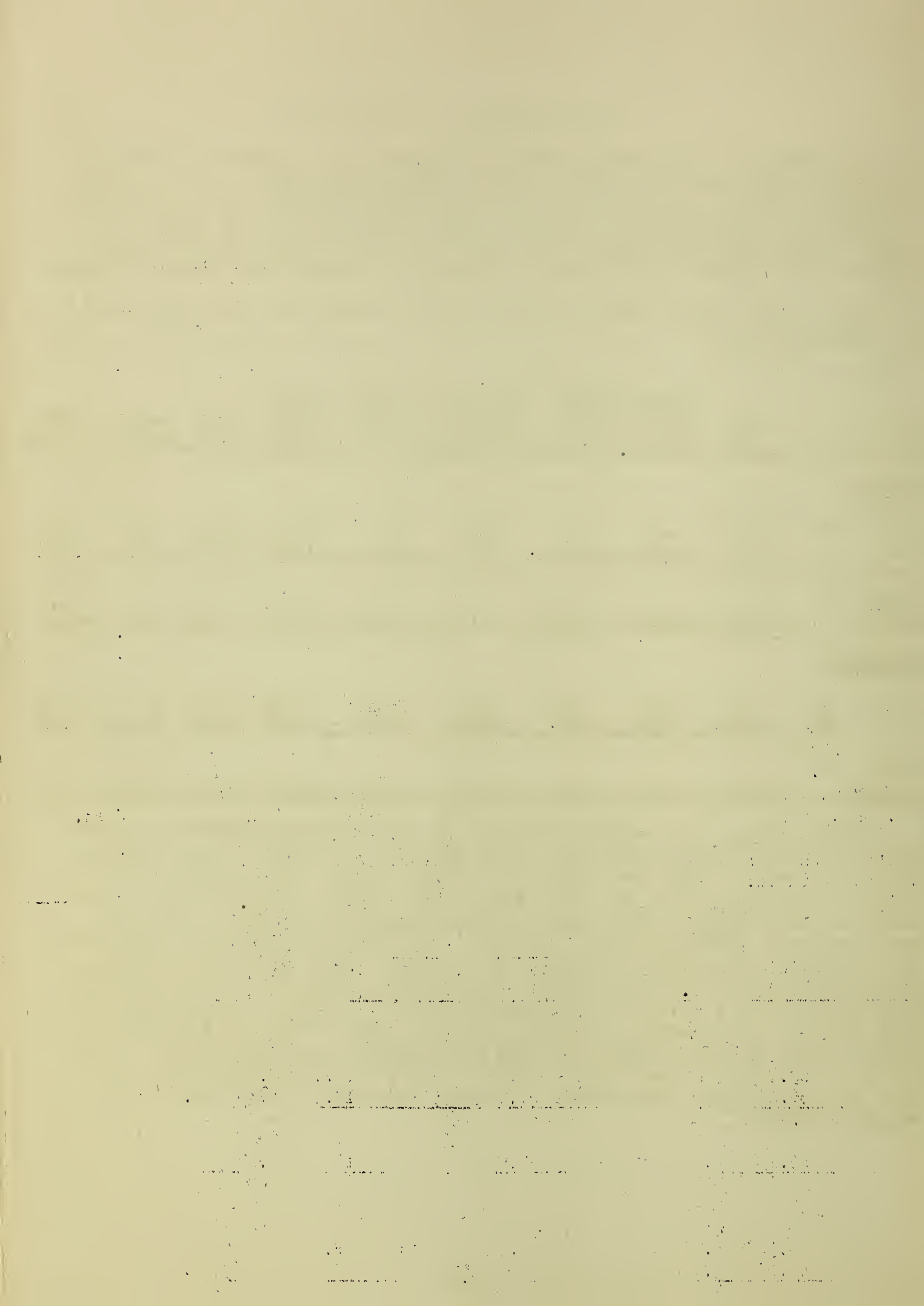
NAVAJO:

1	67	63.80	3.61	2.28	28.2	56's	10.14	0.67	4.09	77.8
2	54	66.46	3.50	2.30	27.1	56's	10.36	0.19	2.67	77.4
Total 121										
Average		65.13	3.56	2.29	27.7	56's	10.25	0.43	3.38	77.6

CROSSBRED:

3	67	45.30	4.39	1.96	26.0	58's	8.24	0.46	2.27	78.8
4	26	49.20	4.16	2.00	26.8	58's	8.57	0.32	1.99	79.6
Total 93										
Average		47.25	4.28	1.98	26.2	58's	8.40	0.39	2.13	79.2

Neither Navajo nor crossbred ewes were quite as well developed as in some years, and fleece weights were well below average as a result of the shedding and loss of wool by many ewes during the spring months. The average fleece weight of 121 Navajo ewes was 3.56 pounds, with a yield of 65.13 percent. This condition is believed to have been caused by injudicious feeding of high protein supplement by inexperienced personnel. The estimated clean wool production of 2.29 pounds represented a decrease of 0.7 pound below the 1936-46 average. Fineness of wool at the side averaged 27.7 microns, grade 56's, but there was a wide range in the fineness of individual fleeces. In terms of fiber diameter, 4.13 percent of the samples classified as fine, 33.06 percent as half-blood, 37.19 percent as three-eighths blood and 25.62 percent as quarter-blood. Kemp and other medullated fibers were present in small amounts, averaging 0.43 percent and 3.38 percent respectively. Average body weight of the Navajo ewes was 77.6 pounds.



The 93 crossbred ewes had an average fleece weight of 4.28 pounds, with a yield of 47.25 percent and 1.98 pounds of clean wool. The latter figure represents a decrease of 1.1 pounds compared to the 1937-46 average for yearling crossbred ewes. The average staple length was 8.40 centimeters, with a fiber diameter of 26.2 microns, grade 58's. Fiber fineness of the crossbred ewes covered a range equal to that of the Navajo ewes, 13.95 percent graded fine, 50.54 percent graded half-blood, 19.23 percent graded three-eighths blood and 11.83 percent graded quarter-blood. Kemp and other medullated fibers amounted to 0.39 percent and 2.13 percent respectively.

It is probable that both the Navajo and crossbred ewes will show substantial improvement in wool production at two and three years of age.

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED RAMS

Fleece weights, yields of clean wool, and fiber characteristics of yearling Navajo and crossbred rams are summarized in the following table:

Breeding	No. of rams	Yield (percent)	<u>Fleece weight</u>		<u>Fineness at side</u>		Kemp (percent)	Other med. fibers
			Grease: (lbs.)	Clean (lbs.)	Diameter (microns)	Grade		
NAVAJO:	17	61.75	6.60	4.06	30.4	50's	0.28	1.68
CROSSBRED:	20	58.07	7.83	4.57	30.4	50's	0.10	0.76

Grease fleece weights of both Navajo and crossbred rams were low but contained a high yield of clean wool. Clean fleece weights of 4.06 pounds for Navajo rams and 4.57 pounds for crossbred rams were equal to production in previous years. The amounts of kemp and other medullated fibers in the fleeces of both Navajo and crossbred rams were negligible in quantity.

GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS

Navajo and crossbred lambs born during the middle two weeks of the 1946 lambing season were weighed individually at 28-day intervals from birth to 140 days of age. Body weights were taken for 73 Navajo lambs and 442 crossbred lambs, representing five different strains or crosses. These data will be used for study of the various factors effecting growth rates of the lambs.

Average body weights of the five groups of lambs at six different ages are summarized in the following table:

GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS

Breeding	Lambs number	AGE					
		Birth pounds	4 weeks pounds	8 weeks pounds	12 weeks pounds	16 weeks pounds	20 weeks pounds
Navajo	73	7.8	17.8	29.0	37.0	41.9	50.3
Crossbred x Crossbred	112	7.9	19.4	31.7	39.9	45.2	54.1
Crossbred x Crossbred	77	7.9	19.9	31.3	39.5	44.3	53.6
Cotswold x Crossbred	106	8.6	20.6	32.3	41.5	46.3	56.3
Columbia x Navajo	147	8.6	20.3	32.8	41.5	46.9	56.6

In 1946 both Navajo and crossbred lambs were lighter in weight at all ages from 4 to 20 weeks of age than lambs of similar breeding reared in 1944 and 1945. At 20 weeks of age Navajo lambs had an average weight of only 50.3 pounds, or approximately 7 pounds below normal weight at this age. Average daily gain from birth to 20 weeks of age was .30 pound. A high percentage of twin lambs and unfavorable feed conditions particularly from birth to 4 weeks of age, and from 16 to 20 weeks of age were primarily responsible for the low rate of gain for Navajo lambs in 1946.

Crossbred lambs were heavier than Navajo lambs at all ages, the differences at 20 weeks of age ranging from 3.3 to 6.3 pounds. Crossbred lambs sired by Cotswold and Columbia rams were heaviest in weight at 20 weeks of age, exceeding the Navajo lambs by approximately 6 pounds and other crossbred lambs by 3.5 pounds. Body weights of the crossbred lambs at 20 weeks were about 5 pounds below normal.

Single lambs were heavier than twin lambs at all ages for both Navajo and crossbred groups. The advantage in weight of single lambs at 20 weeks of age was 9.5 pounds for the Navajo strain and from 9.4 to 12.4 pounds for the crossbred groups. Navajo ram lambs were heavier than ewe lambs at all ages but the sex difference of 1.9 pounds at 20 weeks was considerably less than usual. A similar sex relationship was observed for three of the four groups of crossbred lambs, except that the ewe lambs of the Columbia x Navajo cross were slightly heavier than ram lambs at 20 weeks of age. In the other crossbred group ewe lambs were heavier than ram lambs at all ages from 4 to 20 weeks, with an advantage of 4.2 pounds at the final age. In 1946 the growth rates for ram lambs from 12 to 20 weeks of age were lower than normal as a result of environmental factors. Ram lambs were weaned when body weight reached 50 to 55 pounds, irrespective of age. During the month of August many of the ram lambs developed severe cases of scours and lost weight. This condition was attributed to the consumption of excessive amounts of Russian thistle by the lambs.

DISPOSITION OF WOOL

The 1945 wool clip from the experimental flock of sheep amounted to 5524 pounds. Disposition of the wool is shown in the following summary of sales:

Navajo Service Schools.....	375 pounds
Navajo Arts & Crafts Guild.....	4341 "
Indian Traders.....	194 "
Individual Indians.....	<u>146</u> "

TOTAL.....5056

Eighty fleeces were retained for experimental shrinkage tests.

The Navajo Arts and Crafts Guild received 78.5 percent of the 1945 fleece production, also 1016 pounds of crutchings and tags, and 890 pounds of chrome dyed roving. The latter was produced from wool sheared in 1944. With wool obtained from the laboratory plus 2000 to 3000 pounds purchased from traders, the Guild supplied wool to several Navajo Service Schools, two Navajo Cooperative Stores, and more than 200 individual Navajo weavers on the reservation. The available supply of good weaving wool, however, was inadequate to meet the demand.

RAMS AND RAM LAMBS SOLD FOR BREEDING USE ON NAVAJO INDIAN RESERVATION

Sales of crossbred rams and ram lambs for breeding use were as follows:

Individual Indians - 6 yearling rams
Navajo Livestock Improvement Assoc. - 7 yearling rams, 10 mature rams, and 35 ram lambs

The ram lambs were sold in the fall of 1945 soon after the lambs were weaned, while the yearling and mature rams were sold at breeding time in the fall of 1946.

